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18h International Workshop on Human Subjects for Biomechanical Research

Development of a Hybrid III Intrumented Pelvis for submarining measurement.

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BACKGROUND

. Previous research using the Hybrid II 50° P . dummy (ESV - GOTEBORG - 1989)

. Development a 2-D force transducer for measurement of A - P and I - S loads during submarining process .

. Extensive evaluation involving frontal sled and full scale tests .

OBJECTIVE OF THE PRESENT STUDY

. Adaptation of CAP - SM2D instrumentation to the H III 50° P . pelvis .

. Collaborative effort involving A.P.R and F.T.S.S (Humanetics) teams .

. Further adaptations of CAP - SM2D planned for Hybrid III dummy family .

CAP - SM2D INSTRUMENTATION

. Description, components .

. Attachment to the Hybrid III pelvis.

. Dynamical responses in frontal sled tests.

. Additional equipment for assessment purpose (Iliac wing loads).

ADAPTATION TO THE HYBRID III DUMMY

. Requirements

. Sensor support attached to the lumbar spine bracket .

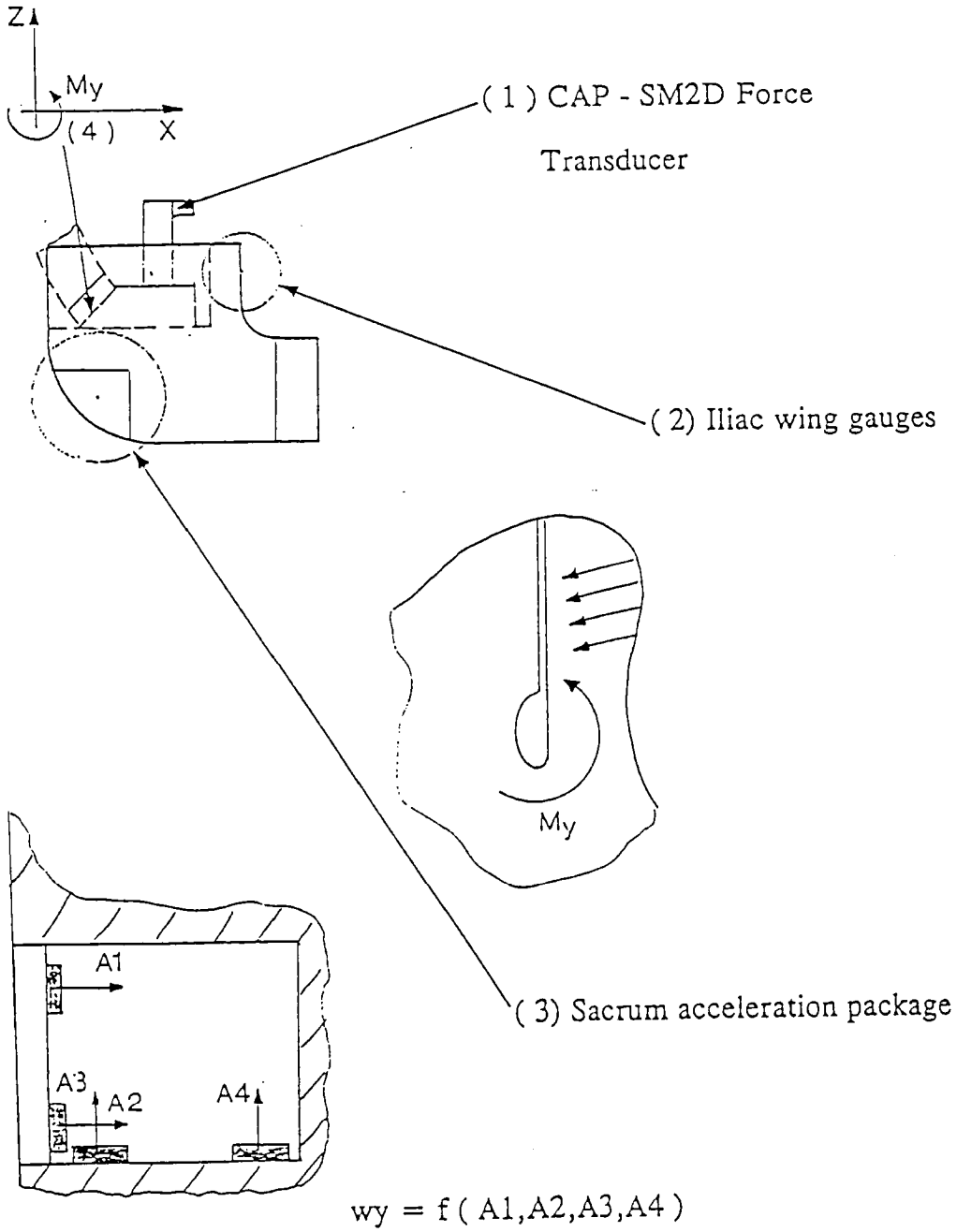
. Easy handling - no modification of the anterior aspect of the pelvis iliac wings .

. Compatibility with Hybrid III lumbar spine force transducer .

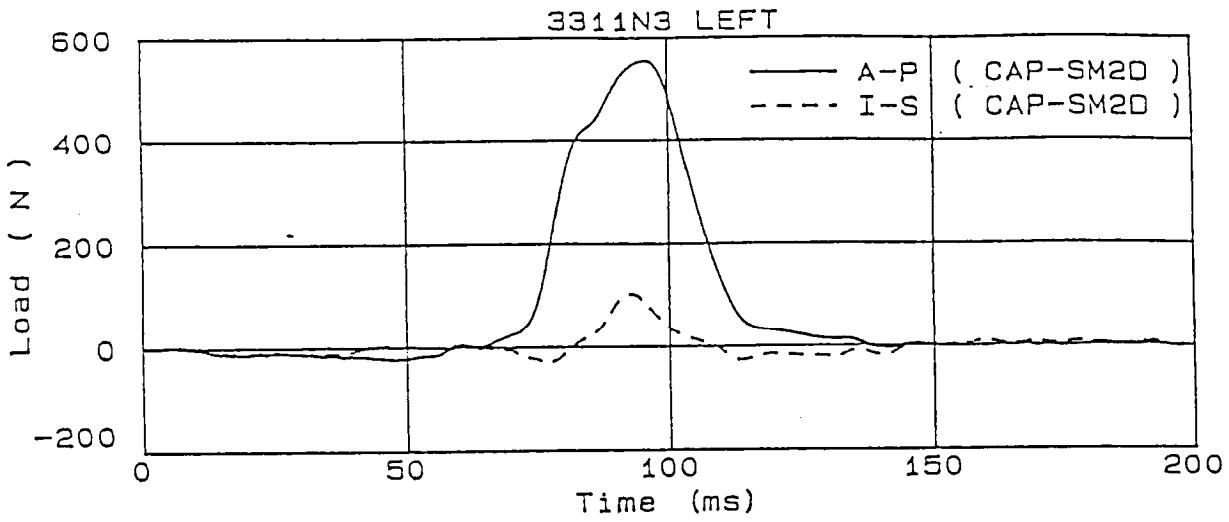
. Additional instrumentation provided in order to assess sensor responses .

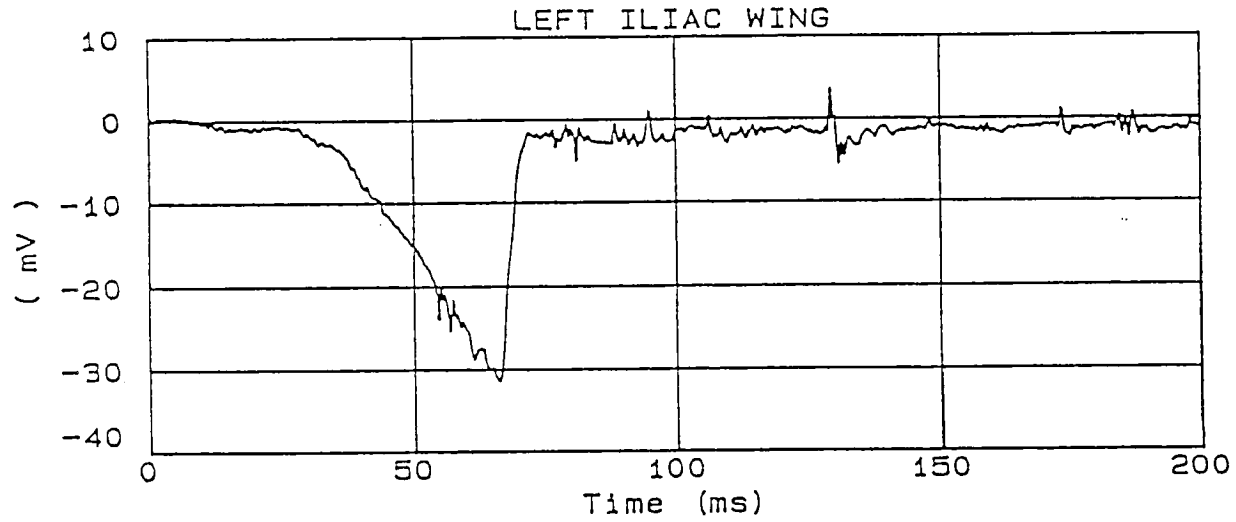
. Slight modifications of the pelvis (lumbar spine bracket) and sensor support .

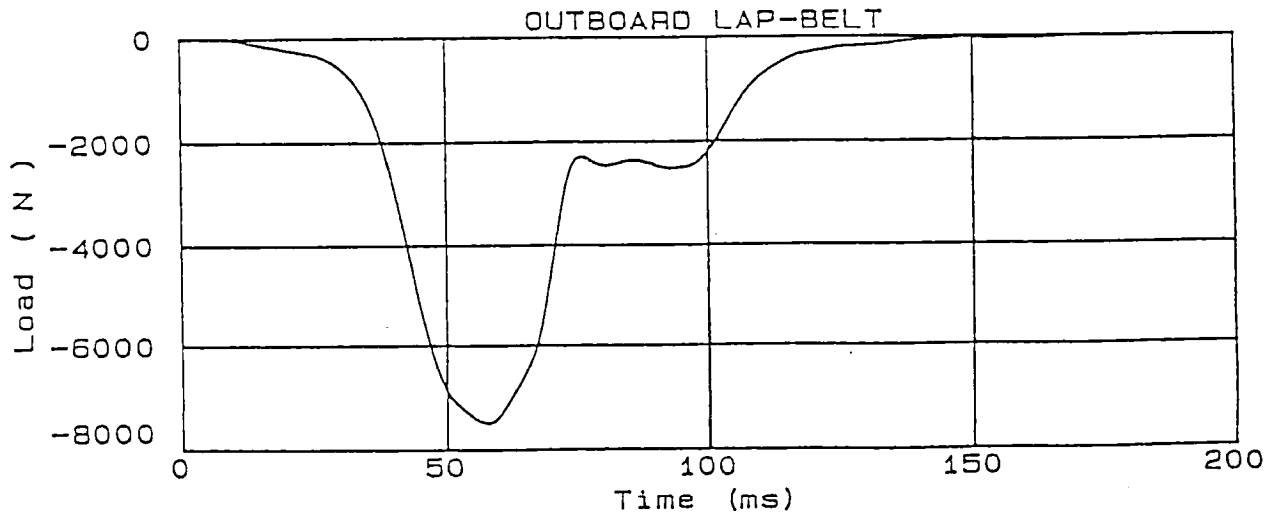
HYBRYD III SUBMARINING PELVIS INSTRUMENTATION PACKAGE FOR EVALUATION TESTS .



wy = f (A1,A2,A3,A4)


3311N3 LEFT
A-P (CAP-SM2D)
I-S (CAP-SM2D)
600
400
200
0
-200
Load (N)
0
50
100
150
200
Time (ms)


LEFT ILIAC WING
10
0
-10
-20
-30
-40
(mV)
0
50
100
150
200
Time (ms)


OUTBOARD LAP-BELT
0
-2000
-4000
-6000
-8000
Load (N)
0
50
100
150
200
Time (ms)

HYBRYD III INSTRUMENTED PELVIS FOR SUBMARINING MEASUREMENT

SUMMARY

THIS INSTRUMENTATION :

- Allows submarining to be determined in terms of time occurrence and magnitude of abdominal loading .
- Has a complete compatibility with other dummy sensors (lumbar spine force transducer, chest deflection potentiometer)
- Involves a simple handling .
- Provides a flat Force - time response in the absence of submarining .
- Provides a dynamical response, in case of submarining, in accordance with pelvic iliac wing loading (by the belt) .

FUTURE DEVELOPMENT / INVESTIGATIONS

- Abdominal biofidelity .
- Dummy post - submarining kinematics .
- Sensor responses compared with additional measurement (Iliac loads, lumbar spine load, w) .

DISCUSSION

PAPER: DEVELOPMENT OF A HYBRID III INSTRUMENTED PELVIS FOR SUBMARINING MEASUREMENT

SPEAKER: Farid Bendjellal, Association of Peugot Renault

Question: Steve Rouhana, General Motors Research Labs, Biomedical Science

From the picture, it appears that the Hybrid III modification of the load transducer sits on the lumbar spine block. Is that correct?

Answer: Absolutely. The support of the load transducer is attached directly to the lumbar spine support and so we modified the lumbar support.

Q: In your sled test, did you compare the kinematic data and dynamic data, such as head and chest accelerations for a dummy without the APR transducer and a dummy with the transducer?

A: Yes, it is exactly the first question that we have to deal with in our future investigation, in fact the sled test to be performed next week. We would like to compare a completely standard Hybrid III dummy with an equipped Hybrid III dummy.

Q: The reason I asked that question is because in our development of the frangible abdomen, we found that there were some changes in the dynamic data with some of our prototypes which were mounted close to the lumbar spine. It was only in the cases when there was no submarining because as the dummy torso bends over forward, the lumbar spine moves forward and we could get contact there. I'm afraid that might happen in this situation, as well.

Q. The second really isn't a question, it's a comment. You said that you didn't think the post-submarining kinematics were necessarily important. However, I would caution you that they may be. The reason I say that is because if you have a device that catches the lapbelt and doesn't allow it to move, it is rigidly caught by that little hook that you have there. That might alter the way the load is being put on the thorax by the lapbelt. If, for example, there was severe submarining, the lapbelt would normally have ridden up and hit the chest or it may also alter the geometry of where the shoulderbelt applies its load to the thorax, so it may be important.

A. I would agree with that. It is a question of objectives. If we say that our objective is to prevent submarining or to control submarining and if we have to analyze only the AP force, then, it is sufficient to keep this kind of parameters. As far as the SI measurement is concerned, when you can get five of six kN, two let's say, five is too much, 2 kN that means that the submarining is very heavy, very, very important and then the design of the

resistance system should be very quickly modified. But in few words, I would agree with you that the tension is something but it depends which objective you are looking for. I would like to comment that as far as the modification of the Hybrid III is concerned, we have preferred to do this job with FTSS Humanetics Company, whose knowledge of the Hybrid III is well known.

Q: Larry Schneider, UMTRI

I was wondering about your future work with a biofidelic abdomen. Do you have any ideas as to how you might approach that and would you come up with something that also used the transducer that you are currently using?

A: The first idea was to consider the deformable foam developed by Steve Rouhana which seems to be complementary to this load transducer. I would say, from my point of view, the best equipment should include, a load transducer, an abdominal foam similar to that which has the same characteristics of that developed by GM, and biofidelic force deflection characteristics of the abdomen. We know that this goal will be very difficult to achieve but we cannot consider only a force transducer, without biofidelic foam. It will be very difficult but we will try.